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Region 7
11201 Renner Blvd.
Lenexa, Kansas 66219

Final Basis of Design

Madison County Mines Site Operable Unit 05 Catherine Mines and Skaggs Tailings Sub-sites

Madison County, Missouri

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1.0 Introduction

The Madison County Mines Operable Unit 05 (OU5) Remedial Action design was prepared by Black & Veatch Special Projects Corp. under contract with the U. S. Environmental Protection Agency Region 7. This document describes the general requirements in conjunction with the Contract Specifications and Drawings.

1.1 Site Location

The Madison County Mines Site, Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number MOD098633415, is located near Fredericktown in southeastern Missouri. The Site is located at the southern end of the Old Lead Belt where heavy metal mining has occurred since the early 1700s. The Site is located about 80 miles south of St. Louis, Missouri, on the southeastern edge of the Ozark Uplift. Past mining operations have left at least 13 identified major mine waste areas, in the form of tailings and chat deposits, from smelting and mineral processing operations in Madison County. Chat deposits include sand to gravel sized material resulting from the crushing, grinding, and dry separation of the ore material. Tailings deposits include sand and silt sized material resulting from the wet washing or floatation separation of the ore material. The mine waste contains elevated levels of lead and other heavy metals which pose a threat to human health and the environment. The limits of disturbance for the entire Site (OU5) are approximately 60 acres.

1.2 Regulatory Background

The Madison County Mines Site was placed on the National Priorities List (NPL) on September 29, 2003. Operable Unit 05 consists of the Catherine Mines and Skaggs Tailings Sub-sites (OU5 CM&STS) along with the three tributaries that flow from the Site.

The EPA signed a Record of Decision for OU 05 on September 27, 2012. The major components of the selected remedies that pertain to the Remedial Design (RD) include the following: (Note that the OU 05 Remedial Design will not address pond or stream surface water sediment contamination.)

- Excavate or grade mine waste, pond sediment, tributary creek sediment as determined necessary, floodplain soils and transition soils to meet the respective cleanup levels.
- Consolidate mine waste in a common repository at each sub-site.

- Grade and contour the repositories and construct drainage systems that will effectively control precipitation runoff to prevent erosion.
- Construct the cover or cap at each repository to consist of 12 inches of clay, 6 inches of topsoil and vegetation.
- Install a monitor well network consisting of a minimum of four wells at each sub-site for groundwater sampling to monitor groundwater quality and hydraulic characteristics.
- Develop and implement a monitoring program for groundwater to ensure shallow groundwater is not migrating from the waste piles. The groundwater monitoring program will continue for a minimum of five years.
- Implement monitored natural recovery (MNR) by developing a monitoring program for sediment and surface water in tributaries and creeks downstream from OU5 CM&STS for a minimum of five years to evaluate the effect of natural processes in preventing downstream migration and to confirm MNR results in protectiveness of human and ecological exposure to contaminated sediments. In order to enhance the successful application of MNR, highly contaminated stream sediment discovered during design sampling will be removed and consolidated under the caps as part of the remedial action. Any remaining stream sediments of concern found during the monitoring period will be addressed under the OU7 – Watershed response action in the future.

1.3 Remedial Action Objectives and Action Levels

The Remedial Action Objectives for the Madison County Mines Site Operable Unit 05 were identified in the Record of Decision, dated September 27, 2012, as the following: (Note that the OU 05 Remedial Design will not address pond or stream surface water sediment contamination.)

- Reduce exposure to humans through routes of ingestion and dermal contact with soil, floodplain soil, mine waste and sediment impacted of Contaminants of concern (COCs).
- Restrict access to groundwater, groundwater consumption and minimize future groundwater contamination to prevent unacceptable exposures.
- Minimize or eliminate COCs migration to surface water levels that ensure the beneficial reuse of these resources.
- Reduce exposure of the ecological system to COCs in sediment and soil.

The Record of Decision (ROD) identified the action levels for Operable Unit 05 to be the following:

- Cleanup levels for mine waste – Consolidation and capping
 - Arsenic: 180 parts per million (ppm)(mg/kg)
 - Cobalt: 130 ppm
 - Lead: 1,460 ppm
 - Manganese: 2,200 ppm
 - Nickel: 380 ppm

A determination will be made through 10 percent comparative analyses during the design phase to confirm historic evidence that achieving the cleanup standard for lead in soil will accomplish meeting the cleanup levels for the other COCs including arsenic, cobalt, manganese and nickel.

- Cleanup level for soil – excavation
 - Lead in residential soil: 400 ppm
 - Lead in recreational soil: 1,250 ppm
- Cleanup level for floodplain soil – excavation
 - Lead: 400 ppm
- Cleanup levels for sediment – removal
 - Lead: 150 ppm
- Cleanup levels for surface water
 - Cleanup levels for surface water are not established since the overall exposure is negligible compared to the presence of COCs in sediment and floodplain soils. Surface runoff will be controlled through the engineering design of the cap to prevent future deposition of contamination to ditches, tributaries and streams.
- Cleanup levels for groundwater
 - Cleanup levels for shallow groundwater are not established as numeric values since shallow, perched groundwater contamination is only documented to exist in the waste piles. The Remedial Action Objectives (RAOs) for groundwater relates to decreasing the volume of precipitation water infiltrating the waste piles. The reduction of precipitation water percolating into the waste piles will further minimize hydraulic mounding preventing groundwater discharges or seeps to the surface at the sides and base of the capped areas.

Consumption of groundwater will be prevented through environmental covenants with property owners under the Missouri Environmental Covenants Act (MoECA) by preventing drilling of wells and potable use of groundwater. Shallow groundwater will be monitored to ensure migration outside the waste piles is not occurring.

1.4 Background Documents

Existing site investigation reports including the following can be found in the Administrative Record File located at the Ozark Regional Library - Fredericktown Branch, 115 South Main Street, Fredericktown, Missouri 63645. Another information repository is located at the U.S. Environmental Protection Agency, Region 7 Records Center, 11201 Renner Boulevard, Lenexa, Kansas 66219.

- EPA Superfund Record of Decision: Catherine Mines and Skaggs Tailings Subsites, Operable Unit 05, Madison County Mines Superfund Site, Madison County, Missouri, CERCLIS ID# MOD098633415, September 2012.
- Final Madison County Mines Site Remedial Investigation Report, Madison County, Missouri (Volumes I-III); Black & Veatch Special Projects Corp. and Professional Environmental Engineers, Inc.; April 2008.
- Final Feasibility Study Report, Operable Unit 5, Madison County Mines Site, Madison County, Missouri; Black & Veatch Special Projects Corp. and Professional Environmental Engineers, Inc.; June 2012.

2.0 Site Background

2.1 Description of Mining Wastes

The mine wastes contain elevated levels of lead and other heavy metals which pose a threat to human health and the environment. These deposits have contaminated soils, sediments, surface water, and groundwater. These materials may also have been transported by wind and water erosion or relocated to other areas throughout the county. It has been reported that the tailings and chat material may have been used on residential property for fill material and private driveways. It has also been reported that the material may have been used as aggregate for road construction and placed on public roads around Fredericktown to control snow and ice.

The Madison County Mines Site was placed on the National Priorities List (NPL) on September 29, 2003. The Madison County Mines site was historically defined by six operable units. OU5 includes the Catherine Mine with its mine waste, pond, and repository and the Skaggs mine waste; OU5 also includes the floodplains and surface water from the Logtown branch and two intermittent streams that flow from the sub sites.

The Catherine Mine sub site is located on the west side of Highway H, about 2 miles northwest of Fredericktown in Section 2, Township 33N, Range 6E. The sub site is about 2,500 feet north of the intersection of Highways H and 67 and is accessed from Highway H. The Skaggs sub site is located near the intersection of Highways H and 67, about 2 miles northwest of Fredericktown in Section 2, T33N, R6E. The sub site is about a quarter mile south of the Catherine Mine sub site and possibly was part of original Catherine Mine sub site.

2.1.1 2008 Sampling Event

A remedial investigation (RI) report for OU5 was completed in 2008 (BVSPC, 2008). During the Catherine portion of the RI, continuous 5-foot core samples through the chat were collected at three locations using a track-mounted geoprobe rig. The chat samples were analyzed for target analyte list (TAL) metals. One sample was analyzed for metals using the toxicity characteristic leaching procedure (TCLP) test. All three of the chat samples collected from the Catherine sub site contained lead concentrations that exceeded the EPA Region 7 preliminary remediation goal (PRG) of 400 mg/kg for residential properties. The chat samples also contained moderate to elevated concentrations of other metals including arsenic, cobalt, copper, iron, nickel, and zinc. Results of the TCLP test indicated that the chat has the characteristic of metals toxicity for lead.

Shallow groundwater collected from the chat area contained low to moderate concentrations of cobalt, iron, lead, manganese, nickel, and zinc. Groundwater concentrations for arsenic, iron, lead, manganese, and sulfate exceeded the EPA maximum contaminant levels (MCLs). In addition, the groundwater concentrations exceeded applicable surface water quality criteria for nickel, chloride, and sulfate.

Surface soil samples were collected from five locations surrounding the Catherine sub site and analyzed for TAL metals. None of the 9 soil samples exceeded the EPA Region 7 PRG for lead.

In general, water quality standards (WQs) were met for all of the contaminants of potential concern in the surface water of the Catherine pond. Sediment in the Catherine pond exceeded human health benchmarks for arsenic, cobalt, iron, lead, manganese, and nickel and exceeded the ecological probable effects concentration for copper, lead, and nickel. The sediment sample in Logtown Branch slightly exceeded the ecological probable effects concentration for lead.

During the Skaggs portion of the RI, continuous 5-foot core samples through the chat were collected at 2 locations using a track-mounted geoprobe rig. In addition, core samples through the chat in the eastern and western piles were collected using a hand auger. The chat samples were analyzed for TAL metals. One sample was analyzed for metals using the TCLP test. All 6 of the samples collected from the chat contained lead concentrations that exceeded the EPA Region 7 PRG for residential soils. The chat samples also contained moderate to elevated concentrations of other metals including arsenic, cobalt, copper, iron, nickel, and zinc. Results of the TCLP test indicated that the chat has the characteristic of metals toxicity for lead.

Shallow groundwater collected from the Skaggs sub site contained low to moderate concentrations of cobalt, iron, lead, manganese, nickel, and zinc. Groundwater concentrations for arsenic, iron, lead, and manganese exceeded EPA MCLs. In addition, the groundwater concentrations exceeded applicable surface water quality criteria for iron, lead, nickel, and zinc.

Surface and subsurface soil samples were collected from five locations surrounding the Skaggs sub site. Lead concentrations in 5 of the 10 surface and subsurface soil samples exceeded the EPA Region 7 PRG for residential soils.

Four surface soil samples were collected from the floodplain of the unnamed tributary stream that drains south-southwest from the Skaggs sub site to Plum Creek and one surface soil sample was collected from the floodplain of an unnamed tributary that drains eastward from the Skaggs sub site to the Little St. Francis River (LSFR). The samples were collected from 15 to 30 ft from the channel and analyzed for TAL metals. Two of the 5 floodplain soil samples exceeded the residential screening levels for lead.

Surface water and sediment samples were collected in an unnamed tributary that drains south-southwest and one sample was collected from a stock pond immediately southwest of the sub site. One measurable sample for dissolved lead in the stock pond exceeded the WQS for aquatic life. Because the analytical reporting limits for cadmium, copper, lead, and silver were higher than the WQSs, it is unknown if water quality within the pond or in the unnamed tributary have been adversely impacted by these constituents. No other metals in the surface waters exceeded the WQSs.

The data from the eleven sediment samples that were collected suggest that arsenic, copper, iron, lead, manganese, and nickel are of concern in the Skaggs area sediments. Lead is of most concern because it exceeded the human health value in 9 of 11 samples and the ecological benchmark value in 10 of 11 samples.

2.1.2 2014 Sampling Event

The most recent sampling event took place in February 2014. Soils at various depths were sampled using an X-Ray Florescence (XRF). There were 114 test pits on the Catherine and Skaggs Sites, 152 surface samples taken around the boundaries of the Catherine and Skaggs Sites, and 104 samples taken along the floodplains of the three tributaries within OU5. A summary of the sample locations and contamination levels for lead can be found in the project specifications.

The objective of the soil sampling was to determine the horizontal and vertical extent of the lead contamination to support the RD. The data has been used to estimate the volume of soil that will be excavated and transported to the repositories for disposal. Sampling locations targeted areas of known waste material and surrounding soils in the vicinity of the Catherine and Skaggs sub-sites. In general, in-situ surface soil samples (0 – 1 inch below ground surface) from the areas around the chat piles were analyzed to determine the horizontal extent of surficial lead contamination. Confirmation soil samples from 10 percent of the in-situ surface soil sample locations were collected and submitted to the EPA Region 7 laboratory for analysis of RCRA metals, excluding mercury; cobalt; manganese; and nickel.

A backhoe was used to excavate the soil at each test pit location. Approximately two test pits per acre were excavated. Subsurface soil samples were collected and analyzed at one foot increments until the lead concentrations were below the cleanup level of 400 mg/kg or the backhoe reached bedrock refusal. Subsurface soil samples were analyzed by collecting grab samples from the bucket of the backhoe. A confirmation soil sample from the bottom of 10 percent of the test pits were submitted to the EPA Region 7 laboratory for analysis of RCRA metals, excluding mercury; cobalt; manganese; and nickel.

The objective of the floodplain soil sampling was to also determine the horizontal and vertical extent of the lead contamination to support the RD. The data has been used to estimate the volume of floodplain soil that will be excavated and transported to the chat piles for disposal. Sampling locations targeted areas along banks of the stream channel of the Logtown Branch and two intermittent streams. In-situ XRF readings were taken every 250 feet along each side of the streams to establish the distance from the stream where the lead concentration was below 400 mg/kg. The vertical depth of contamination was determined by excavating the soil with a shovel at the midpoint between the stream bed and the location where the lead concentration in the surface soil was less than 400 mg/kg. In-situ XRF readings were taken in the excavated area at six inch intervals until the depth where the lead concentration was below 400 mg/kg.

2.2 Chemical Concentrations

Remedial investigation sampling results are provided in the Final Remedial Investigation report prepared by Black & Veatch Special Projects Corp. and Professional Environmental Engineers, Inc.

Additional field investigations were conducted at the Site as part of this remedial design. The field investigations included the excavation of test pits and floodplain soils and collection of surface soil samples throughout the OU 05 area. Soil samples were analyzed for lead using portable XRF devices. The results of the soil sampling are provided in Specification Section 31 00 00.

2.3 Property Ownership

The properties involved with the Madison County Mines Site OU 05 remedial action are privately held. EPA will provide the contractor with access agreements for performing the work. Properties affected or potentially affected by the effort for OU 05 include the following:

| Parcel Number | Owner's Name(s) |
|----------------------|--------------------------------|
| 03703500000001000 | Howell, Carl H. & Clara Etal |
| 06110100000001401S | Hufford Investments Lp |
| 06110100000001404S | Madison Co. Mo. Public Water |
| 061101000000003S000 | Jones, Carl R & Jonnie L |
| 061101000000008S000 | Father Lewis-Tucker Home |
| 061101000000010S000 | Sonderman, Wm. P. & Alexanda |
| 061101000000012S000 | Bell, P. Irene |
| 061101000000014S000 | Ramond Skaggs |
| 0611020000000001000 | Priday, Thomas |
| 0611020000000002000 | Delta Asphalt, Inc |
| 0611020000000008000 | Kemp, Larry D & Linda K |
| 0611020000000008001 | Hufford Ineestments Lp |
| 0611020000000009000 | Hovis, Clyde Shelby |
| 061102000000003M000 | Delta Asphalt, Inc |
| 061102000000003S000 | Sikes, Charles E & Barbara |
| 061102000000006M000 | Anschutz Mining Co. |
| 061102000000006S000 | Hufford Investments Lp |
| 0612110000000001004 | Hufford Investments Lp |
| 0611010000000001004 | Hinkle, William Scott |
| 0611010000000001407S | Hufford Investments Lp |
| 0611010000000001016 | Bell, Robert C. & P. Irene |
| 0611010000000001019 | Rehkop, Ronald Dale & Monica L |
| 0611010000000001023 | Streib, Phillip L & Thyra A |
| 0611020000000008002 | Hufford Investments Lp |
| 0611010000000001029 | Clark, John & Melissa |
| 0611020000000002001 | Jones, Carl R & Jonnie L |

3.0 General Description of the Work

This section provides a general description of the work. Detailed description of the work and activities are provided in the Contract Specifications and Drawings. If any conflict exists between the information provided in this section and the Contract Specifications and Drawings, the Contract Specifications and Drawings take precedence.

3.1 Work Activities

The remedial action for Madison County Mines Site OU 05 is detailed in the Contract Specifications and Drawings. The work generally includes the following activities:

- Clearing and grubbing as identified on the drawings.
- Excavation of mining wastes within the limits shown on the drawings and disposal of the mining wastes in repositories on the site.
- Collection and analysis of confirmation soil samples.
- Erosion and sediment control of excess water produced during disposal of wastes.
- Protection of existing utilities, including telephone, sewer, and water lines.
- Final grading of the site.
- Establishment of vegetative stand.
- Construction of a final cover over the repositories.
- Health and safety.
- Installation of groundwater monitoring wells.

3.2 Sequencing of the Remedial Action

The Madison County Mines Site OU 05 remedial action will be conducted according to the following general sequence of events.

- All activities will be completed during a single construction effort. The activities to be conducted will include:
 - Clearing and grubbing.
 - Excavation of mine and mill wastes and contaminated soils.
 - Disposal of mine wastes and contaminated soils in onsite repositories.
 - Verification soil sampling.
 - Final grading.
 - Seeding.

- Erosion and sediment control.
- Groundwater monitoring well installation.

4.0 Major Design Components

4.1 General Conditions

4.1.1 *Mobilization*

Mobilization shall be performed as identified in Contract Specification Section 01 50 00.

4.1.2 *Temporary Office Space*

Temporary facilities for administrative field offices and storage areas shall be provided as identified in Contract Specification Section 01 50 00. Contractor shall provide utility services as stated in the Contract Specification Section 01 50 00.

4.1.3 *Decontamination Areas*

Decontamination areas shall be established for personnel and equipment to prevent the spread of contamination into the support zone and to offsite areas.

4.1.4 *Erosion and Sediment Control*

Erosion and sediment control shall be provided as indicated in Contract Specification 01 57 23 and as shown on the Contract Drawings. Control measures to be used shall include at a minimum silt fences and stone filter rings.

4.1.5 *Clearing and Grubbing*

Clearing and grubbing will be conducted to the extent needed within the limits shown on the Contract Drawings and in accordance with Contract Specification Section 31 11 00.

4.1.6 *Haul Roads and Traffic Control*

The Contractor shall maintain haul roads and control traffic around the site as indicated in Specification Section 01 50 00. Traffic control will be designed by the

contractor and coordinated with MODOT.

4.1.7 Site Security

Contractor shall provide security for temporary facilities and storage areas as identified in Specification Section 01 50 00.

4.1.8 Health and Safety

The Health and Safety requirements are identified in Specification Section 01 35 29.13.

4.1.9 Existing Utilities

Existing utility locations shown on the Contract Drawings are approximate only and may not reflect field conditions. The contractor is responsible for locating prior to excavation. If utility locations conflict with the excavation plans, the contractor shall notify the engineer.

4.2 Excavation and Mine Waste Handling

Mining and mill wastes and contaminated soil from the Site shall be excavated and disposed of in the repositories shown on the drawings. The Contract Drawings indicate the approximate extent of excavation based on the test pit, floodplain, and surface sampling conducted during the remedial design. The actual extent of excavation required will be determined by confirmation samples taken as part of the contract work. The mine and mill wastes and contaminated soil shall be disposed of by placement within the repositories within the OU 05 (Catherine and Skaggs) area as indicated on the Contract Drawings. Waste placement will be staged to the extent possible so that wastes with highest concentrations of lead shall be placed in the deeper depths of repositories to arrest oxidation, weathering, and acid generation processes. Wastes with lower concentrations of lead shall be used as fill in the upper portions of the repositories.

4.3 Vegetation

All disturbed areas shall be seeded in accordance with Specification Section 32 92 19. The Contractor shall collect representative samples of the soil at final grade to determine the amount of nutrients needed to promote the growth of the vegetation.

4.4 Cover System

A soil cover system shall be constructed over the wastes disposed of in the repositories as shown in the Contract Drawings and identified in the Contract Specifications. Additional borrow material shall be placed as needed to meet the final grade. Vegetation established on the repository areas shall be destroyed prior to placement of the cap.

The soil cover shall be constructed as indicated in Specification Section 31 00 00 of 12" of clay based soil covered with 6" of topsoil mixed with nutrients as necessary for seeding. Hydroseeding shall be done on cover in accordance with Specification Section 32 92 19.

4.5 Monitoring Well Installation

Eight monitoring wells (four in the vicinity of each repository that are projected to be at depths 20'-30' deep) shall be installed around the repositories at locations identified on the Contract Drawings and as indicated in Specification Section 33 24 00.00 20.

4.6 Permit Requirements

Permit Requirements are identified in the Contract Specifications. Section 33 24 00.00 20 requires that a well permit be filed with the state.

5.0 Contract Specifications

The Contract Specifications for the Madison County Mines Site OU 05 are provided under separate cover. The Contract Specifications include the following:

| Section | Title |
|----------------|--|
| 01 11 00 | Summary of Work |
| 01 35 29.13 | Health, Safety, and Emergency Response Procedures for Contaminated Sites |
| 01 35 45.00 10 | Chemical Data Quality Control |
| 01 50 00 | Temporary Construction Facilities and Controls |
| 01 57 23 | Temporary Storm Water Pollution Control |
| 31 00 00 | Earthwork |
| 31 11 00 | Clearing and Grubbing |
| 32 92 19 | Seeding |
| 33 24 00.00 20 | Monitoring Wells |
| 33 40 00 | Storm Drainage Utilities |
| | Sampling Results: Sample ID, Depth, Location |

6.0 Contract Drawings

The Contract Drawings for Madison County Mines Site OU 05 are provided under separate cover. The Contract Drawings include the following:

| Sheet Number | Drawing Title |
|----------------|------------------------------------|
| Cover | Cover |
| G-001 | Location Map |
| C-001 | Index Plan |
| C-101 to C-106 | Existing Conditions |
| C-201 to C-206 | Excavation Grading Plans |
| C-301 to C-306 | Final Grading Plans |
| C-401 to C-406 | Erosion and Sediment Control Plans |
| C-501 to C-504 | Construction Details |
| C-601 to C-602 | Monitoring Wells Plan |

7.0 References

1. Dames & Moore, *Final Remedial Investigation, Neck/Alba, Snap, Oronogo/Duenweg, Joplin, Thomas, Carl Junction, and Waco Designated Areas, Jasper County Site, Jasper County, Missouri*; October 31, 1995.
2. EPA 540/R-R-04-004 *USEPA Contract Laboratory Program National Functional Guidelines for In Organic Data Review*, 1999
3. EPA 240-B-01-003 *USEPA Requirements for Quality Assurance Project Plans*, 2001
4. EPA 505-B-04-900A *Uniform Federal Policy for Quality Assurance Project Plans*, 2005
5. EPA 600-R-98-018 *USEPA Guidance for Quality Assurance Project Plans*, 1998
6. EPA Method 6200 *Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment*, 1998